ADDITIONAL OBSERVATIONS ON THE PARASITES OF MAN AND DOMESTIC ANIMALS.

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In the following pages some species of parasites are added to those enumerated in the last report, as found in the domestic animals. Many additional facts have also been ascertained concerning the habits and history of several of the species previously described, and some of the more important of these discoveries will be noticed here.

Internal Parasites of Man.

The name of the following species in the list, (Report for 1870, p. 170,) should be changed to the earlier one given by Diesing. *Bilharzia hæmatobia* Cobbold, 1864, should be *Gynæcophorus hæmatobius* Diesing, 1858.*

Internal Parasites of Cattle.

Ascaris lumbricoides Linn. Small intestine. This species, which was accidentally omitted from the list (page 176) of the last report, but mentioned on page 235, should be added. It is regarded as perfectly identical with the common "round-worm" of man.

Internal Parasites of the Horse.

The following species should be added to the list, (p. 177.)

Onchocerca reticulata Diesing. A small nematode worm, resembling *Trichina*, found in the muscles and tunics of the arteries.

Pentastoma Settenii Diesing. Found in the eye.

Internal Parasites of the Hog.

The names of the two following species should be changed.

Strongylus dentatus should be *Sclerostomum dentatum* Rud.

Sclerostomum pinguicola should be *Stephanurus dentatus* Diesing.

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* Revision der Myzhelminthen; Trematoden: Sitz. Akad. der Wissenschaften, 1858, p. 356.

Internal Parasites of Poultry.

The following species should be added to the list on page 179, Report for 1870.

CESTODES.

Tænia megalops Nitzsch. Intestine of ducks.
T. gracilis Rud. " " "
T. trilineata Batsch. " " "
T. coronula Dujardin. " " "

T. echinococcus? A species allied to or identical with the common *echinococcus* has been found in the encysted state in the lungs of the turkey.

TREMATODES.

Monostomum attenuatum Rud. Intestines and cæcum of geese.
Distoma cuneatum Rud. In the oviduct of a pea-hen.
D. echiniferum La Val. Intestines of ducks, pigeons, &c.
D. armatum Molin. Intestines and cæcum of hens.

NEMATODES.

Ascaris gibbosa Rud. Intestines of hens.
A. dispar Schrank. Intestines of geese.
A. vesicularis Frölich. Large intestines and cæcum of hens, peacock, and turkey.
Filaria anatis Rud. Heart of ducks.
Spiroptera nasuta Rud. Crop of hens.
S. tricolor Diesing. Tubercles in crop of ducks.
Tricosomum brevicolle Rud. Intestines and cæcum of geese and ducks.
T. longicolle Rud. Large intestine and cæcum of hens, geese, &c.
T. tenuissimum Dies. Large intestine of pigeons.
Eustrongylus tubifex. Œsophagus and crop, often in tubercles, in ducks and various other aquatic birds.

Of those previously enumerated as found in ducks and geese, the following have also been found in hens: *Tænia malleus* Goeze, *Notocotyle triserialis* Diesing (same as *Monostomum triseriale*), *Distoma ovatum* Rud. *Ascaris inflexa* Rud. is found in the intestines of ducks as well as hens.

The Broad Tape-worm of Man, (*Bothriocephalus latus* Bremser.) Report for 1870, p. 212.

It has been ascertained by Dr. Koch that this species lives while in the young or larval state in running streams, attached to stones, instead of being parasitic in some fish, as had been previously supposed. Therefore we may expect that it will, sooner or later, be introduced into the streams of our own country, in regions settled by emigrants from those parts of Europe infested by it; for the mature worm has often been found in such emigrants in various parts of the United States.

Echinorhynchus gigas Goeze, (See Report for 1870, p. 220.)

This common intestinal worm of the hog, has attracted much attention recently, on account of its remarkable structure and mode of growth.

It has been ascertained by Mr. E. G. Balbiani,* that although the development of the eggs commences before they are laid, it soon ceases and can proceed only after the eggs are discharged and fall to the moist earth or water; that several months elapse in winter before the embryos hatch, and the hatching may be delayed a year without destroying the vitality of the embryo; and that the eggs will not hatch in the intestine of the animal in which the adult worm resides, but pass into the body of some other animal, where the embryo passes through its first stages of growth.

Professor A. Schneider† has traced its development and history quite satisfactorily. According to his observations the history is as follows: The ova of this worm are scattered upon the ground by the pigs harboring the adult worms in their intestines. They are then devoured by the larvæ of the cockchafer beetle, (*Melolontha vulgaris*, allied to our "May-bugs,") in which they develop. The ova burst in the

* Comptes-rendus, Vol. lxix, p. 1091, 1869.

† Sitzungsbericht der Oberhessischen Gesellschaft für Natur- und Heilkunde, March, 1871. Also, translated in the Annals and Magazine of Natural History, Vol. 7, p. 441. 1871.

stomachs of the beetle-larvæ, and the embryos thus liberated penetrate by means of their boring spines through the intestines into the body cavity of the larvæ; here they become more developed, and finally reach the intestines of the pigs when the latter devour the beetle-larvæ containing them, and there grow to maturity. When the embryos have arrived in the body cavity of the larvæ of *Melolontha*, they remain for some days unaltered and capable of motion; they then become rigid, acquire an oval form, and envelope themselves in a finely cellular cyst, which is formed of the connective tissue of the larva. The skin of the embryo, with its circlet of spines at the anterior end, continues at first to be the skin of the growing larva, and it is only at a later period, when the formation of the hooks commences, that it is thrown off, when it forms a second cystic envelope.

The beetle-larvæ infested with the young *Echinorhynchi* live on until their metamorphosis into cockchafers. As the thorax of the cockchafer is sometimes eaten by man, we can understand that the *Echinorhynchus gigas* may also get into the intestines of man. It has once been found in that situation by Lambl. Professor Schneider also describes the development and metamorphosis of the larva of the *Echinorhynchus*, with reference to its internal organization.

It is probable that in this country the eggs of this parasite hatch in the larvæ of the May-bugs (*Lachnosterna*), and goldsmith-beetles (*Catalpa lanigera*), which are allied to the cockchafer of Europe and have similar habits. These larvæ are large, plump, whitish or yellowish grubs, usually darker posteriorly, and furnished with three pairs of legs. They are always abundant in manure heaps and in the soils of yards and gardens, but are also found in fields and pastures, so that there are abundant opportunities for them to get at the eggs of the *Echinorhynchus*, dropped by the pigs, and for them to be devoured in their turn by the pigs.

The bronchial Strongylus of Horses and Cattle. (*Strongylus micrurus* Mehlis.) See page 240, Report for 1870.

During the past year a serious outbreak of the disease caused by this parasite occurred in Alleghany County, New York, which caused the death of many calves and the serious disease of all the cattle on the farm. Some of the worms were sent to me for examination, by Thomas L. Harison, Esq., secretary of the New York State Agricultural Society. They proved to be identical with this species, long known and dreaded by the farmers of Europe. Professor James Law, who investigated this case, as well as two others of less importance which occurred previously, has published a full and interesting acount of them, in the Journal of the New York State Agricultural Society, for July and August, 1871, from which the following extracts have been made:

"I have been able to find no proof of the existence of this disease among our sheep, and the only evidence of its existence in calves is derived from the particulars of three outbreaks in different parts of New York, and about which I was consulted.

The first of these took place in the autumn of 1869, among the calves of Mr. Wood, Woodville, N. Y., and though one or two had already died, the malady was easily controlled by putting in practice the measures advised in this paper.

The second outbreak, which was only reported to me recently, occurred on the farm of Mr. Sutton, Ovid, Seneca county, N. Y. In this case four yearlings, fed during the previous autumn on a sloping dry orchard, and watered from a stream in a ravine close by, were attacked in March, 1870, while confined to the yards and fed on clover hay, with water from the stream. Two died in from six to ten days after the seizure, a third remained in low condition and perished in July, and the fourth recovered. On this same farm the chickens and turkeys perished last summer in great numbers from *the gapes*, and squirrels have furnished specimens of bronchial

parasites. The third outbreak took place in July last, on the farm of Mr. S. P. Swift, Cuba, Alleghany county, N. Y. Nineteen calves were attacked, eleven of which had died at the time of my visit, and all the cows on the farm coughed and looked badly. The cows with which the malady probably originated, grazed on a partially cleared field, full of stumps and brush, and abounding in springs and marshy places. They were driven home to milk along a road between the fields occupied by the two lots of calves, and could easily interchange courtesies with them over the fences. Seventeen of the calves kept in one field got water from a deep, enclosed well in the centre of the field, while the remaining two never had water but only milk. The calves lived, on an average, from nine to fifteen days after they were attacked. Treatment, as recommended, thoroughly destroyed the adult worms, as I failed to find one in the bronchial ramifications of a calf examined and which had been but twice fumigated, while in those that died before the treatment I had prescribed had been put in practice an abundance of worms were found. The yearlings on the same farm, kept on a separate field and without any means of communication with the cows or calves, escaped the disease.

An incident which occurred while one of Mr. Swift's calves was being skinned, throws some doubt on the fatality being due to the worms alone. A cat which licked some of the blood died on the spot, and before the skin was separated from the body; the body of this calf — the only one skinned—is further said to have appeared much infiltrated with black blood, which points to *bloody murrain—charbon*—as the immediate cause of death in this case at least. A cow, too, had suffered some time previously from an equivocal swelling on the jaw, which burst and discharged an unhealthy sanious liquid.

This complaint is probably much more frequent in calves in this country than has been yet recognized, and with our constant importations of English long-wooled sheep it will be a marvel if we fail to import their pulmonary parasite.

In describing the disease it will be convenient to consider

it under different heads, grouping together those animals which harbor the same species of worm.

Verminous bronchitis in the ox, horse, ass, and mule.—The same parasite attacks one and all of these animals. This is the *Strongylus micurus* of Mehlis, a small, thread-like worm, the male one and a half inches long, the female three inches. The head is rounded, with no constriction or neck, the mouth furnished with three chitinous papillæ, the œsophagus club-shaped, the genital orifice of the *female* situated in the anterior half of the body, and the tail pointed: the male has a caudal pouch with five rays standing well apart. They were noticed by Camper to be viviparous, but this must be qualified by the statement that the female, after becoming imbedded in the lung substance, or after being expelled by coughing, perishes often with its oviducts still full of ova, and these gradually hatch out amidst the decomposing debris of the parent.

Development.—The development of the parasites has to be considered as it takes place *in* and *out* of the body. *Within the body* in the earlier stages of their life—that of ova and embryos—the parasites are found imbedded in the substance of the lung-tissue, mostly toward the margins of the lobules, where they may live for indefinite but often long periods. Baillet killed a lamb thirty-two days after he had administered the embryos of a Strongylus filaria taken from the oviducts of a female worm, and found the parasites rolled up into pellets in minute semivitreous nodules in the posterior part of the lungs, and varying in length from one-third to a line. It is probable, therefore, that these lung-infesting strongyli may live for many months encysted in the pulmonary tissue in this imperfect condition. The appearance of the lung so affected is redder than natural, and its surface feels rough and uneven by reason of the numerous exudations around the embryo worms. These nodules, which were long mistaken for miliary tubercles, vary in size from that of a pin's head to that of a barley corn, while at certain points many will become accumulated so as to cause uniform consolidation of lung-tissue to a considerable extent. They vary, too, in consistency from a simple semifluid mass to a hard calcareous shell. The soft and

semitransparent spherical nodules contain the younger worms, often microscopic, and without sexual development, while the larger and dark colored cysts contain worms of nearly their full size, and furnished with sexual organs. Some of the larger cysts are not spherical, but irregular in outline, and these, on being opened, are found to contain the debris of the parent worm with numerous ova and microscopic embryos, mixed up with an abundance of pus cells, granular masses and granules. At times, more or less of the worms approaching maturity may be seen making their way through the mucous membrane from the pulmonary cysts to the bronchial tubes.

The second stage of their existence, and that in which they are most injurious to their hosts, is that of the sexually mature parasite in the bronchial tubes. They may be found at all points from the throat down the windpipe and through the smallest ramifications of the air tubes, either singly imbedded in the frothy mucous, or in large numbers rolled into pellets, and it may be, completely obstructing the bronchial tubes. The mucous membrane of these tubes is reddened, softened, and inflamed, and the smaller tubes that have harbored the worms for some time are usually dilated much beyond their natural size. Many thousands of these worms often exist in the lungs of a single animal, and as one worm will produce its thousands of eggs, capable of contaminating a large herd, their presence in any particular stock ought not to be lightly passed over.

Colin, who has investigated this subject very thoroughly, says: "The strongyli of the calf remain in the vesicular tumors a much shorter time than those of the sheep. They are encysted and quiescent but for a short period and spend most of their life in the bronchia, where they accumulate in masses which intercept the passage of air through many of these tubes and produce an intense dyspnœa, or even slow but fatal asphyxia, the lung tissue meanwhile containing marked traces of the passage of the parasite. There are cases where the bronchia in the lungs of the calf are so invaded that the lobules furthest from the larger bronchial tubes are denied

the entrance of air. The strongyli accumulate in hundreds in inextricable pellets which the air cannot traverse. Thus these lobules appear to be hepatized."

"The strongyli fill the bronchia of the calves' lungs during the first year, but they do not long obstruct them; they die and are eliminated at the end of a season."

"This is the mode of reproduction of these worms: The females, twice as large as the males, have a long resistant oviduct, sinuous and folded upon itself, containing, from its depth to its terminal orifice, eggs in all phases of incubation. At first they are scarcely recognizable; afterwards are others of which the yolk is divided into 2, 4, 8, or 16 spheres, and whose surfaces are irregular, like that of a raspberry; further on, the eggs contain a curved immovable embryo; at last an embryo in the form of the figure 8, in a loop, or in a spiral, like the Trichina in its muscular cyst."

"It is not necessary that the female should remain alive in order to the laying of the eggs; even when she dies the expulsion of her progeny is assured. If she lays them in the bronchia, the young ones are developed or expelled. If her progeny must be preserved for a more propitious season, or for another age of the animals which harbors them, she encloses herself in a tubercle in one of the air sacs, afterwards dies and is transformed into a veritable bag of eggs, destined to furnish, insensibly and for a long period, the contingent which the living worm would have been able, in other circumstances, to render at one laying."

"The two habitats of these worms thus coincide each with one period of their life and with certain circumstances of their reproduction. In the cyst they hatch successively with a certain slowness, remain small, asexual, and live surrounded by the debris of their mother. Later, they develop in the bronchia, become sexual, adult, copulate, and prepare, it may be, for emigration externally, it may for a new (*internal*) reproduction in the lungs, during which they constitute numerous reserves for all the period of the life of the mammifer, as is a possible case, not for the calf, but for the sheep."

"*Out of the body* of their host the life of these worms in water

is thus described by Colin: "After the death of the mother its body swells, its skin is torn off, and the oviducts float free, and masses of eggs and myriads of embryos escaping disperse themselves at the bottom of the water. I have watched for eight days in succession the continuance of this hatching, the little ones always showing the same vivacity alike in the clearer parts of the water and in the vicinity of the detritus from which they have sprung. Whilst a certain number died, there still remained a prodigious quantity, soon, however, becoming mingled with infusoria developed in the liquid."

"There are here two facts: the birth of the worms in the dead body of their mother, and the external life of the little ones, the cause and condition of the contagion. In effect, the animals, of which the bronchia conceal the strongyli, reject them under the influence of cough and the expectoration of mucous charged with worms, which fall on the food, the litter, upon the soil, or in the water drunk; the mothers die, but the eggs are hatched, and the living brood wait till they have the opportunity of entering the bodies of the animals. It is, above all, in water that they are long preserved outside the animal economy. I have watched them in pools of fresh and stagnant water, the one destitute of vegetation, the other penetrated with confervæ or covered with lentiles, dead leaves and divers debris. The adult worms died at the end of some days. From their carcases the oviducts escaped, carrying with them eggs in all stages of development. Incubation, already well advanced during life, is continued without interruption. The embryos are expelled from the shell and dispersed in the water during one, two, three, four, five, or six weeks, according to the temperature and other conditions of the liquid. The development takes place more regularly in fresh water than in salt; in river than in spring water; in pools with lentiles and confervæ than in pools exposed and slimy. It was notably retarded, but not suspended, in fetid water charged with carburetted and sulphuretted hydrogen. These worms are so tenacious of life that their evolution takes place in the customary manner, even in water in which portions of the infested lungs have been macerated.

The septic element disengaged from these putrid fragments retarded the development of the strongyli, but failed to arrest it. And even if the experimental troughs contained a very large amount of water, the strongyli disengaged themselves in great numbers from the morsels of putrid lungs; and, though reduced to a putrid pulp, the eggs could be seen amidst this ready to open, and the young worms escaping from their envelopes."

"It is in fresh water that the worms are most readily developed, and live longest after leaving their natural habitat. Water is a transition medium in which the worm which has abandoned one animal can survive, waiting a favorable opportunity to enter another. In this medium the strongyli are hatched and live for entire weeks and months without perceptible growth, that is to say, they preserve their primary microscopic proportions. They can there resist sudden changes of temperature and the deleterious influence of putrid matters, whilst they wait an occasion of entering with the aliments into the body of a new host, in whose air passages they find the conditions necessary to their assuming the attributes of sexuality and reproducing their kind.

Causes.—These are, of course, primarily and mainly the introduction of the embryo strongyli into the system, but many other conditions may combine as accessory to the preservation and propagation of the worms. Thus, *wet seasons*, by providing moisture or pools for the preservation of the embryos, contribute to their wider diffusion. In keeping with this we find the first record of the disease as existing in the low wet grounds of Holland, and the two by Despallens as occurring in the wet summers of 1795 and 1811. The same holds good in England alike as regards the prevalence of the disease in the low fenny counties, and in rainy seasons; and these remarks apply to other animals as well as calves and lambs. A donkey, from the low meadows at Hammersmith, London, rarely failed to yield a supply of the strongyli. And in the present year, which has proved unusually cold and wet in the British Isles, we are not surprised at the serious complaints of the extraordinary death of pheasants from *gapes*.

The cows on Mr. Swift's farm at Cuba, with which the disease probably originated, were pastured in a new field full of stumps and brush, and abounding in springs and marshy places. A *second accessory* is to be found in the *youth of the animals*, the weakness of which and the abundance of secretions from their mucous membranes predispose to this as to other parasitic affections. *Weakness* from ill health or old age may be classed along with this. But, perhaps, the most important of these accessory causes is feeding on *contaminated fields or fodder*, or drinking from *troughs or streams containing the worms*. In the affected counties of England calves and lambs are especially liable to suffer, if pastured on fields previously eaten down with older stock. Overstocking has also its evil influence, partly by reason of its weakening the constitution of the animals, and partly by causing an extraordinary accumulation of embryo strongyli in the pastures and drink.

Symptoms.—The symptoms are esentially those of bronchitis, with this difference: that the examination of the mucous coughed up shows the presence of the worms either solitarily or rolled together into bundles. The symptoms, however, vary a good deal in different cases. There is, at first, only a slight cough, rather hoarse and hacking, and repeated at irregular intervals. The coat stares, the skin feels dry, inelastic and unhealthy, and emaciation perceptibly advances day by day. Sometimes the cough is not observed at first, and these symptoms alone, or with some slight embarrassment of breathing when exercised, are the sole manifestations. Soon, however, the cough becomes more frequent and occurs in paroxysms which threaten suffocation, and sometimes induce it. The matters expelled by the nose and mouth are found, on examination, to contain more or less of the worms, appearing like pieces of stout white thread, one to three inches long.

Often when the cough is less frequent, it is at the same time soft and loose, or even wheezing rather than hoarse; the patient becomes daily weaker and more hide-bound, the visible mucous membranes get pale, the eyes sunken, the ap-

petite fails, the animal leaves its fellows and may be found in a corner of the pasturage or under a tree, its skin covered with vermin and flies, which it no longer has the vigor to brush off. The patient finally dies in a state of extreme weakness.

Worms in the bowels often form a serious complication, though one too much overlooked. From the presence of these arise indigestions, tympany (bloating), and above all, diarrhœa, which rapidly exhaust the strength and hasten death.

The parasites found in the intestines of oxen in such cases are chiefly: the Strongylus radiatus, in the small intestines, and the Tricocephalus affinis and occasionally the Sclerostomum hypostomum in the larger intestines. These are merely the common parasites of the ox, which increase in direct ratio with the debility and the improper condition of the aliments. The same holds good in the horse and ass. In similar conditions their small intestines contain the Ascaris megalocephala, and their large intestines the Sclerostomum equinum, the S. tetracanthum and the Oxyuris curvula. To describe these worms at length would unnecessarily extend this paper, and serve no good purpose.

Duration.—In ordinary cases, calves will live two or three months after being attacked, although the blocking up of the windpipe or principal bronchial tubes by pellets of worms, or the accumulation in the lungs of ova and embryos to the extent of causing a general inflammation, may at any time precipitate death. Mr. Swift's calves died at periods of from nine to fifteen days after they were noticed to be ill." * *

"*Prevention.*—Two indications present themselves as calculated to prevent this disease:—1st. To prevent the worms from gaining access to the system; and 2d. To bring the animal into a condition unfavorable to the development and destructive work of the worms.

Under the first head might be mentioned many specific precautions: 1st. In localities where the parasite is known to exist, *lambs or calves should not be depastured on land recently*

occupied by sheep or by older cattle or horses. Lambs may be safely grazed after horses or cattle, or foals and calves after sheep, but no young animal in such place should be allowed to graze after any creature liable to harbor the specific parasite, to whose attack its lungs are obnoxious. 2d. *Overstocking should be avoided.* If the parasite is introduced on any pasture, the facilities for its increase will be in exact proportion to the number of animals present in whose lungs it can attain full sexual development and reproduce its kind. 3d. *Thorough drainage will go far to prevent it.* As the young worms must live in water or in moist earth, the facilities for their preservation will be increased according to the springy or marshy nature of the soil. 4th. Young stock must not be allowed access to water coming from a field containing beasts infested with its own pulmonary parasite. 5th. Pastures or water in which any particular pulmonary parasite has gained a footing should be denied to all animals known to harbor that particular parasite, or still better, the soil may be torn up with the plough and subjected to a rotation of other crops until time has been allowed for the destruction of the germs. 6th. No affected or suspected animal should be placed with others, nor in their pastures, until time has been allowed and measures taken to rid it of the unwelcome visitant. 7th. Feeding young animals on grass wet with dew, or on clover or other such fodder as affords by its abundant moisture a suitable nidus for the young worms, is to be avoided. 8th. Carcases of those dying of the affection should be deeply buried.

The testimony of English farmers is strongly against second crop grass, and above all, clover which has been fed off with sheep or beef cattle, as the case may be, in the spring; and that eminent Prussian breeder, Baron Von Nathunsius, Hundisburg, Magdeburg, asserts that though the *filaria* in lambs was formerly very frequent and pernicious in his neighborhood, he has not observed it for twenty years, since they took to feeding the lambs in sheds, on hay and roots, during the wet season.

Under the second head, that of enabling the animal to resist the worms and their effects, may be mentioned: 1st. The

importance of good feeding; and, 2d. The value of a free supply of salt. Most English flock-masters speak of the necessity of keeping the lambs in good condition, partly with the view of enabling them to prevent the worms from effecting a lodgment in their bodies, but mainly to enable them to survive the depressing effects attendant on the presence of the parasite. One man finds that the fatality of the disease diminishes very materially where his lambs are fed roots; another lauds oil-cake as being nearly a preventive, and a third saves most of his lambs by feeding well after weaning. The disease is found to be quite as prevalent in wet seasons as in dry ones, if not more so, but the mortality always increases with the dryness, and the lack of nutrient food. The use of salt is based on the fact elucidated by Dr. Crisp and others, that contact with a solution of this agent is promptly fatal to the young worms.

Remedial Treatment.—This resolves itself into: 1st. Supporting the strength of the animal; 2d. Destroying the intestinal and pulmonary parasites; and 3d. Combating pneumonia or any other complication which may supervene. Attention must, of course, be given to prevent the access of more parasites to the system by partaking of contaminated food, water, or mingling with diseased flocks or herds.

To support the strength, the patients must be liberally fed on oil-cake, rape-cake, roots, corn, oats, beans, or other sound nutritious diet, to which may be added a mixture, in eqnal parts, of powdered sulphate of iron, gentian, and ginger, in the proportion of four ounces of the mixture to every ten calves, daily—lambs may take two ounces to the same number, daily, at three months old.

To destroy the intestinal parasites, common table salt may be given to lambs in doses of a teaspoonful every other morning, dissolved in water, and to calves in doses of three teaspoonfuls. Oil of turpentine is perhaps, more efficient, and may be given to strong three months lambs in doses of two teaspoonfuls, or to calves of the same age in doses of a tablespoonful, well shaken up in milk. These doses should be given in the morning fasting, and repeated the third day.

To dispose of the lung parasites is a more difficult matter, not because the worm is less easily killed, but because the young worms and, above all, the ova encysted in the substance of the lungs cannot be reached. The worms living free in the windpipe and bronchia may be readily destroyed by causing the affected animal to inhale sulphurous acid or chlorine gas. The agent first named is preferable as being less irritating than chlorine, as exercising, indeed, when sufficiently diluted in air, a soothing and antiphlogistic action on the inflamed bronchial mucous membrane. It is best administered by burning flowers of sulphur in a close house, but into which air can be readily and freely admitted in case of need, and in which both the patient and administrator are enclosed. It is commonly advised to throw sulphur on hot coals, but, as the latter give off carbonic acid and render the air unwholesome, I have adopted the plan of twisting up a small piece of soft paper into a cone, putting into this a pinch of sulphur and burning it, holding meanwhile by the twisted point of the cone. The sulphur fumes are to be evolved in this way until the air of the apartment is impregnated as strongly as the administrator and his patient can bear without violent coughing. Breathing of the sulphur fumes should be kept up for half an hour or as long as the air of the building remains impregnated with it, and should be repeated at least three days in succession. At the end of a week, should the patient survive, the smoking should be repeated to destroy the parasites which have been hatched in the interval. The same process may have to be repeated once more, though if the ova in the lungs are so numerous as to endanger life after this, the inflammation caused by their presence will probably speedily cut off the patient.

Chlorine gas may be set free by mixing in a cup or saucer common salt, peroxide of manganese, and sulphuric acid. It is equally efficient with sulphur smoke, but much more irritating and to be used with greater care. Indeed, this matter of smoking by either agent should only be trusted to the most careful and intelligent persons, otherwise serious accidents may ensue.

In the worst cases the accumulation of worms and ova in the lung tissue produces an extensive inflammation of these organs and renders all treatment unavailing. This has been treated by blistering, wine, &c., but rarely with any measure of success."

The Strongylus of the Hog's Intestines, (*Sclerostomum dentatum* Rud.) See p. 241, Report for 1870.

In the last report this species was erroneously described as a true *Strongylus*, owing to the probable occurrence of two different but related species in the hog's intestine, one of which is probably a true *Strongylus* and the other a *Sclerostomum*. The original species described by Rudolphi appears however to belong to the genus *Sclerostomum*. According to Diesing, it had the following characteristics, some of which differ from the description given in the report for 1869.

Head truncate; border of the mouth with ten or twelve small recurved teeth. Body straight, tapering to both ends. Bursa of the male three-lobed, the intermediate lobe smaller; rays three, undivided. Caudal extremity of the female straight, subulate, the genital aperture above the apex of the tail. Length of the male, 5 or 6 lines; of the female, 6 to 7 lines; diameter one-fourth of a line.

The "Kidney-worm" or "Lard-worm" of the Hog. (*Stephanurus dentatus* Diesing, or *Sclerostoma pinguicola* V. Report for 1870, p. 248.)

Since the publication of the last report much additional information has been obtained concerning this destructive parasite, which proves to be one of the most abundant and widely diffused of all those infesting domestic animals. It is also probable that it annually causes greater pecuniary loss than any other parasite.

Soon after the publication of my description of this worm in the last report, and also in the *American Journal of Science*, my attention was called to several other cases in New England. In one of these, numerous large specimens were found in the leaf-lard of a pig raised in Litchfield county, in this state.

These occupied large irregular cavities or cysts, sometimes an inch long, containing a considerable amount of dark colored and disagreeable matter, like pus, in which many eggs were also found. In some of the cavities two or three worms occurred together, in others but one. This pig had been dressed and sold in New Haven as sound and healthy. By an examination of these fresh specimens and others I have been able to determine the form and structure of the worm more precisely than could be done with the badly preserved specimens originally described. Soon afterwards I received drawings and specimens of the same parasite from Dr. Wm. B. Fletcher, of Indianapolis, Ind., who had also sent specimens to Dr. Cobbold, with information concerning its habits. Dr. Cobbold identified the worm with the species described by Diesing* from specimens obtained by Natterer in Brazil in a Chinese variety of the hog. He also published an article on the subject in the *British Medical Journal*, and in "*Nature*," Jan. 26, 1871, calling attention to its importance. I have also satisfied myself that this identification is correct, on examination of the perfect specimens referred to above, although Diesing's description does not apply in all respects to the specimens which I have examined. Dr. Cobbold errs, however, in supposing that this species has been entirely overlooked in this country up to this time, for in 1858, Dr. J. C. White† noticed the occurrence of the same worm (which he referred doubtfully to *Stephanurus dentatus*,) in the leaflard of a hog. It appears to have been well known to pork producers for a long time under the name of "kidney worm." Dr. Cobbold has published another more lengthy article on the same subject in *Nature*, Oct. 1871, p. 508, in which he translates Diesing's original description and gives interesting facts received from Dr. Fletcher concerning its habits and injurious effects in this country. He also records its discovery in Australian hogs by Dr. Morris.‡

*Systema Helminthum, Vol. ii, p. 296, 1851. Also in Annalen des Wiener Museums, ii, p. 232, Tab. xv. (anatomy), 1839.

†Proceedings of the Boston Society of Natural History, Vol. vi, p. 428.

‡Monthly Microscopic Journal, Nov. 1871, p. 243.

Dr. Fletcher had, however, already published an interesting and important article on the same parasite in the *American Journal of Science*, June, 1871, p. 435, from which the following extract has been taken:

"This worm was brought to me in 1866, by a farmer whose hogs were dying of cholera. He had removed the lungs of several, and also cut out fragments of the liver, all of which were spotted over with little cysts containing the worms; in the bronchial tubes down to the minutest branches, they were found in abundance and in situations where no one could have placed them.

With these specimens my conclusion was that they were the *Filaria bronchialis* of Owen, or *Strongylus bronchialis* of Cobbold, and not having at this time made microscropic examinations of our well known kidney-worm, the relationship between them did not occur to me at that time.

In November, 1870, while demonstrating the portal circulation in the liver of a pig, full grown, I observed a worm which measured an inch and a half in length, and in all respects resembled the kidney-worm, and also reminded me of the worms I had examined five years before. Upon further dissection of the liver I found the worms not only free in the portal veins, but in cysts in various portions of the organ; also some were found in freshly cut holes, directly across the hepatic lobules. The gall-bladder was distended with a dirty yellowish fluid, the consistency of soft boiled eggs, and although no worms were found, yet the ova were abundant, as they also were in the fluid of the cysts.

Being convinced that the worm formerly examined in the lungs was the same as the worm now found in this new locality, and finding it oviparous, I gave up my opinion as to its being a *Filaria bronchialis*.

From the date of this discovery, I frequented the slaughter houses and pork-packing establishments, and found the worm in most instances in the pelvis of the kidney, or in cysts in the fat around them. Four times I have found the worm in the bronchial tubes, twice in the hepatic vein and the right side of the heart; also in cysts throughout the fatty parts of the animal.

Frequently, when no worms were discovered, the eggs were abundant in the thick mucus-looking fluid in the pelvis of the kidney. This fluid contained, besides eggs, desquamated renal tubules, or casts and oily granules.

In no instance have I found worms in an immature state, which shows that the eggs, in all probability, go through some other host before they enter the swine, to become sexually mature.*

The symptoms in hogs, which are referred to the "kidney-worm," are due to a paralysis of motion in the hind legs; the hog draws the hind quarters along the ground from place to place in search of his food, although it is by no means proven that the worm is the real cause, unless we be able to demonstrate its existence in some cerebro-spinal center, or some point more likely to destroy the reflex power in the cord itself.

Structure.—The head and oral cavity are alike in male and female. The oral cavity is rather oval than round, and is surrounded by a hexagonal frame, each corner having a papilla and hooklet, while each side is armed with six serrate teeth.

Looking into the oral cavity, it is funnel-shaped, having three openings at the back, one of which connects directly with the œsophagus, while the others appear to connect with the water vessels.

The intestine is long and contains some pigment granules, arranged in dentritic forms, throughout its length; the whole is thrown into convolutions, and gives an almost black appearance to the worm, except when the white oviducts distended with eggs, or the seminal vessels of the male are folded over the intestine, when it has a white, mottled appearance.

The caudal extremity of the female is spindle-shaped, but has two little bursæ higher up. In the male it is formed by three-lobed bursæ, above which are two well developed flexible spicula."

*It is quite as probable that they may hatch in water, and thus enter the hog's stomach with its drink.—v.

I may add that in fresh or well preserved specimens the caudal extremity of the male terminates in three conical, obtuse papillæ, from the midst of which the slender, curved male organ often projects; these papillæ are nearly enclosed by the "bursa," which is close to the end of the body. When spread out and seen from behind this has a somewhat rectangular form, being broadest laterally, each of the lateral expansions consisting of two small lobes united together to near their ends, while the intermediate odd lobe is shorter and scarcely prominent. Or the bursa, instead of being called five-lobed, as described by Diesing, might, with equal propriety, be described as consisting of two larger, bilobed lateral lobes, and a smaller intermediate lobe which is closely united to them. The caudal end of the female is blunt, suddenly narrowing to a small, obtuse papilla-like tip, which is placed excentrically; a short distance in advance of the end are two small, rounded, vesicle-like, lateral prominences. The dark, chitinous ring around the mouth is finely denticulated along its edge, and usually bears six stronger teeth, two of which, on opposite sides, are usually larger and stouter than the others, but not invariably so; sometimes, especially in the larger females, they are more than twice as large as the rest. In some specimens I also observed two opposite papillæ near the mouth, from each of which a minute, short, slender spine projected. The anterior end of the female is more obtuse than that of the male. The largest females from the Litchfield county pig were 1.75 inches long and .08 to .10 of an inch in diameter. The largest males were 1.35 long and .06 thick.

Dr. Fletcher writes that he believes that this parasite causes greater pecuniary loss than any other known. He has found it in nine out of ten hogs examined. He also suspects that it may be the cause of the hog cholera.

Some experiments undertaken by me to trace its history and development have not as yet thrown any light upon the subject. We are still in complete ignorance concerning the circumstances under which the eggs hatch and the abode of the young worms. Until such information can be obtained

no reliable advice can be given as to the modes in which the spreading of the disease can be best prevented. It is most probable, however, that the eggs are hatched in water or moist earth, and that the young worms are swallowed directly by the hogs while drinking.

Although this parasite probably does not live in the human body in any stage of its growth, there can be no doubt but that the pork and lard from hogs infested by them must be unwholesome. That such diseased pork is constantly sold in our markets is certain.

The Human Bot-fly (Dermatobia noxialis?).

In the last report, (page 95), it was mentioned that a species of bot-fly lives in the larval state beneath the human skin, forming painful tumors. But such instances had been observed only in the tropical parts of Central and South America. It is, therefore, of interest to record a similar case in the United States. In this instance, a young woman, twenty-two years old, residing at Meridian, Mississippi, was the victim of the insect. The larvæ, developed from eggs deposited in the skin by the fly, caused great irritation and pain in the sub-cutaneous tissues, resulting in large abscesses, from which the mature larvæ finally escaped.

I am indebted to Dr. Wm. B. Fletcher, of Indianapolis, Ind., for a specimen of the larvæ of the insect which was taken from this patient and sent to him by Dr. Jas Hughes, who treated the case. Whether it be identical with the South American species cannot be determined from the larvæ alone.